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2826

PATENT APPLICATION

ATTORNEY DOCKET NO. 10004405-1

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Duane Fasen et al.

Serial No.: 09/938,394

Examiner: Mandala, Victor A.

Filing Date: August 23, 2001

Group Art Unit: 2826

Title: Bottom Antireflection Coating Color Filter Process For Fabricating Solid State Image Sensors

COMMISSIONER FOR PATENTS
Washington, D.C. 20231

TRANSMITTAL LETTER FOR RESPONSE/AMENDMENT

Sir:

Transmitted herewith is/are the following in the above-identified application:

(X) Response/Amendment
( ) New fee as calculated below
(X) No additional fee (Address envelope to "Box Non-Fee Amendments")
( ) Other: _____ (fee $_____)
( ) Petition to extend time to respond
( ) Supplemental Declaration

CLAIMS AS AMENDED BY OTHER THAN A SMALL ENTITY						
(1) FOR	(2) CLAIMS REMAINING AFTER AMENDMENT	(3) NUMBER EXTRA	(4) HIGHEST NUMBER PREVIOUSLY PAID FOR	(5) PRESENT EXTRA	(6) RATE	(7) ADDITIONAL FEES
TOTAL CLAIMS	11	MINUS	20	= 0	X $18	$ 0
INDEP. CLAIMS	1	MINUS	3	= 0	X $84	$ 0
[ ] FIRST PRESENTATION OF A MULTIPLE DEPENDENT CLAIM					+ $280	$ 0
EXTENSION FEE	1ST MONTH $110.00 [ ]	2ND MONTH $410.00 [ ]	3RD MONTH $930.00 [ ]	4TH MONTH $1450.00 [ ]		$ 0
					OTHER FEES	$
					TOTAL ADDITIONAL FEE FOR THIS AMENDMENT	$ 0

Charge $ 0 to Deposit Account 50-1078. At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account 50-1078 pursuant to 37 CFR 1.25. Additionally please charge any fees to Deposit Account 50-1078 under 37 CFR 1.16, 1.17, 1.19, 1.20 and 1.21. A duplicate copy of this sheet is enclosed.

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Date of Deposit: **Feb. 4, 2003**

Typed Name: **Edouard Garcia**

Signature: _____

Respectfully submitted,

Duane Fasen et al.

By _____

Edouard Garcia

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- Attach as First Page to Transmitted Papers -

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Title : Bottom Antireflection Coating Color Filter Process For Fabricating Solid State Image Sensors

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RESPONSETO EXAMINER'S ACTION DATED DECEMBER 4, 2002

I. Status of Claims

Claims 1-23 are pending.

II. Objection to the Drawings

The Examiner has objected to the drawings under 37 CFR § 1.83(a). In particular, the Examiner has indicated that "the antireflection layer being present only in regions under the color filter array material must be shown or the feature(s) canceled from the claim(s). FIG. 5, however, clearly shows an image sensor system with a bottom antireflection coating 16 that is present only in regions under color filter array material 14. For at least this reason, the Examiner's objection to the drawings should be withdrawn.

III. Rejections of Independent Claim 13

Independent claim 13 requires an image sensor system that includes a bottom antireflection coating disposed between a color filter array and an active image sensing device structure.

CERTIFICATE OF MAILING

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Edouard Garcia
(Typed or printed name of person mailing papers)

A. Rejection Under 35 U.S.C. § 102(b) Over Daly

The Examiner has rejected independent claim 13 under 35 U.S.C. § 102(b) over Daly (U.S. 5,654,202). In particular, the Examiner has indicated that (emphasis added):

> The Applicant defines the bottom reflection layer in Amendment B as a layer that may suppress unwanted resist-activating radiation by absorption or wave-cancellation, or both. Daly defines the planarization layer 18 as a layer that is photoresponsive, (Col. 9, lines 12-13), and transparent to wavelengths of light at which the device operates, (Col. 3, lines 52-55). The examiner finds the Applicant's definition of the bottom antireflection layer to be the same as Daly et al.'s planarization layer 18 because the Applicant explains the layer to absorb radiation, which is found to mean the same as transparent to wavelengths of light, (Daly et al.) which a transparent layer allows the passage of a specified form of radiation.

It is unclear what the underlined portion of the above quotation means. In any event, contrary to the Examiner's assertion, planarization layer 18 does not operate as a bottom antireflection coating. Moreover, based on Daly's teaching, one of ordinary skill in the art would not understand that planarization layer 18 could be a bottom antireflection coating.

It is acknowledged that Daly teaches that planarization layer 18 may be formed of a photosensitive material. However, before the color filter array 19 is formed, such a photosensitive planarization layer 18 is exposed to resist-activating radiation that changes the structure of the layer to create "differences in the dissolution properties of the coating" (col. 5, lines 56-57). In particular, the photoactive compounds in such layers photochemically decompose in response to the resist-activating radiation (see, e.g., the following portions of Daly's disclosure: col. 6, lines 6-8; col. 6, lines 24-27; col. 6, lines 48-50; col. 7, lines 3-7; and col. 7, lines 22-25). As a result of the decomposition of the photoactive compounds, exposed areas of photosensitive layers 18 no longer absorb resist-activating radiation.

Furthermore, before the color filter array 19 is formed, Daly teaches that planarization layer 18 must be stabilized so that it does "not swell and distort or absorb dye during the coating and dyeing steps which are an integral part of the CFA fabrication" (col. 7, lines 55-56). To this end, Daly teaches that:

> Typically, stabilization is effected by hardening or crosslinking the surface of the planarization layer by baking, with a crosslinking exposure by treatment with a plasma or with a combination of these treatments. In the case of negative imagable planarization layers which are crosslinked, baking alone may be adequate to form a tight stable network. Treatment with a non-oxygen plasma alters the chemistry of the surface while concurrently bathing the wafer in high intensity deep ultraviolet light. In each case, the process yields a planarizing layer which does not swell with solvent and which does not absorb dye. (Col. 7, lines 52-67)

Thus, before the color array is formed, the planarization layer 18 is processed into a stabilized, substantially inert layer. There is no teaching in Daly of what the optical properties of the stabilized planarization layer is or should be other than that the planarization layer must be "substantially transparent at wavelengths of light at which the device operates" (col. 3, lines 54-55). The material structure resulting from such a stabilization process would not absorb resist-activating radiation because any photoactive compounds that might be present in planarization layer 18 before the stabilization treatment would decompose during the stabilization treatment. For this reason, Daly does not even hint that after being stabilized the resulting planarization layer 18 is absorptive of resist-activating radiation and, therefore, is able to operate as a bottom antireflection coating during formation of the color filter array.

In sum, Daly's planarization layer 18 may be photosensitive at one stage of the process of making image sensor 20. However, before the color filter array 19 is formed, such a photosensitive planarization layer 18 is processed into a state that is not responsive to resist-activating radiation. Consequently, Daly's planarization layer 18 does not operate as an antireflective coating during the formation of color filter array 19.

For at least these reasons, the Examiner's rejection of independent claim 13 under 35 U.S.C. § 102(b) over Daly should be withdrawn.

B. Rejection Under 35 U.S.C. § 102(e) Over Yang

The Examiner has rejected independent claim 13 under 35 U.S.C. § 102(e) over Yang (U.S. 6,184,055). In particular, the Examiner has asserted that Yang's passivation layer in FIG. 7J corresponds to a bottom antireflection coating (emphasis added):

> It is apparent in Yang et al.'s design that the passivation layer is an antireflection coating because in Col. 10 Lines 22 & 29-31 explains that metal layers M1 and M2 are used to shield non-photosensing regions and additional layers may be added to [do] that but it does not state that the passivation layer performs this task. It is apparent that the passivation layer allows light to transmit through, thus being an antireflection coating.

In addition, the Examiner has indicated that (emphasis added):

> The Applicant defines the bottom reflection layer in Amendment B as a layer that may suppress unwanted resist-activating radiation by absorption or wave cancellation, or both. The Applicant explains that the antireflection layer absorbs radiation, which a transparent layer allows the passage of a specified form of radiation. The Examiner finds the Applicant's definition of the bottom antireflection layer to be the same as Yang et al.'s passivation layer.

It is unclear what the underlined portion of the above quotation means. Applicant's specification teaches that, in some embodiments, "BARC layer 16 preferably is substantially absorptive of radiation in the wavelength range used to pattern color filter array 14 and is substantially transmissive of radiation in the wavelength range to be imaged by image sensor 10" (page 6, lines 14-17). Such a BARC layer is perfectly consistent with the description of a bottom antireflection coating as a coating that is disposed between a patterning resist layer and underlying reflective structures to enhance control of critical dimensions in the patterning resist layer by suppressing reflective notching, standing wave effects, and the swing ratio caused by thin film interference.

The mere fact that Yang's passivation layer is transparent to light within an operating wavelength range does not suggest that the passivation layer operates as a bottom antireflection coating. Indeed, the only teaching in Yang regarding the passivation layer is that the "passivation layer is formed for protecting the device from moisture and scratch" (col. 10, lines 23-24). Based on this limited teaching, one of ordinary skill in the at would understand that Yang's passivation layer is a conventional dielectric passivation layer, such as the silicon dioxide or silicon nitride passivation layer 17 in Daly's imager design. There is no teaching whatsoever in Yang that would have led one of ordinary skill in the art at the time of the invention to tailor the absorptive properties or the refractive properties, or both, of Yang's passivation layer so that it would suppress back reflections during the formation of

the color filter array. Thus, there is no basis for the Examiner's assertion that "Applicant's definition of the bottom antireflection layer [is] the same as Yang et al.'s passivation layer."

For at least these reasons, the Examiner's rejection of independent claim 13 under 35 U.S.C. § 102(e) over Yang should be withdrawn.

IV. Rejections of Dependent Claims

Dependent claims 14-23 incorporate the features of independent claim 13 and, therefore, these claims are patentable for at least the same reasons explained above. Dependent claims 14, 16, and 21-23 are patentable for the following additional reasons.

For the purpose of the following discussion, the examiner is reminded that:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not on applicants' disclosure.

MPEP § 706.02(j). Furthermore, as pointed out by the Patent Office Board of Appeals and Interferences:

> The examiner should be aware that "deeming" does not discharge him from the burden of providing the requisite factual basis and establishing the requisite motivation to support a conclusion of obviousness.

Ex parte Stern, 13 USPQ2d 1379 (BPAI 1989).

A. Claim 14

The Examiner has rejected claim 14 under 35 U.S.C. § 103(a) over Daly in view of Dixit (U.S. 6,106,995).

With respect to the subject matter recited in dependent claim 14, the Examiner has indicated that:

> Referring to claim 14, wherein the bottom antireflection coating comprises a dyed organic antireflection film-forming material, (Dixit et al. Col. 2, lines 9-11 and Col. 2, lines 15 & 16).
>
> It would have been obvious to combine the teachings of Daly et al. and the teachings of Dixit et al. because the dyed organic antireflection film reduces the reflectivity from the substrate allowing proper sensing from the sensor.

The Examiner has further indicated that:

> One skilled in the art would find it obvious to combine the teachings of Daly et al. with Dixit et al. because Daly et al. and Dixit et al. antireflection layers perform the same as the Applicants'. Daly et al. discloses the claimed invention except for an organic antireflection layer. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use an organic antireflection layer as taught in Dixit et al., since it has been held to be within the general skill of a worker in the art to select a known material on the basis for the intended use as a matter of obvious design choice.

As explained above, Daly's planarization layer 18 is not a bottom antireflection coating. Thus, contrary to the Examiner's assertion, Daly's planarization layer 18 does not "perform the same as Applicants'" bottom antireflection coating. Consequently, the Examiner's basis for the position that the substitution of one of Dixit's antireflection coatings for Daly's planarization layer 18 would have been a matter of obvious design choice does not apply.

In addition, there is no teaching or suggestion in either Daly or Dixit that would have led one of ordinary skill in the art at the time of the invention to substitute one of Dixit's antireflection coatings for Daly's planarization layer 18, as proposed by the Examiner. Dixit teaches that the thickness of the antireflection films should be on the order of about 56-80 nm. Such thicknesses would not be sufficient to planarize topographic features of the device region in Daly's imager. Therefore, replacing Daly's planarization layer 18 with one of Dixit's antireflection films, as proposed by the Examiner, would defeat Daly's objective to provide a smooth, uniform surface over the active device area for a color filter array. A

modification that would defeat the object of Daly's invention hardly would have been obvious to one of ordinary skill in the art. As explained in MPEP § 2143.01:

> If [a] proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification.

Accordingly, the Examiner's proposed combination of Daly and Dixit is impermissible.

The Examiner has indicated that the "Applicant does not give valid arguments that tend to the wording of the claimed matter in claim 14." However, the issue with respect to the Examiner's rejection of claim 14 is whether the combination of Daly and Daly, as proposed by the Examiner is permissible. The fact that Dixit's antireflection film thicknesses are too small to be used as Daly's planarization layer and, therefore, one of ordinary skill in the art at the time of the invention would not have been motivated to make the modification proposed by the Examiner is directly relevant to the issue. The fact that claim 14 does not recite anything about the thickness of the BARC layer does not detract from the validity and the persuasiveness of this line of reasoning.

For at least these additional reasons, the Examiner's rejection of dependent claim 14 under 35 U.S.C. § 103(a) over Daly in view of Dixit should be withdrawn.

B. Claim 16

The Examiner has rejected claim 16 under 35 U.S.C. § 103(a) over Daly in view of Murakami (U.S. 6,060,732).

There is no teaching or suggestion in Daly that the thickness of planarization layer 18 should be selected to improve an optical transmission characteristic of one or more colors of the color filter array. However, with respect to the subject matter recited in dependent claim 16, the Examiner has indicated that:

> It would have been obvious to combine the teachings of Daly et al. and combine them with the teaching of Murakami because adjusting the thickness of an antireflective film would allow adjustment of the focal point and to the refractory angle, thus allowing the sensor to be adjusted and properly sense. These teachings are well known in the art and by people who wear [g]lasses.

The Examiner has further indicated that (original emphasis):

> Murakami et al. teaches that adjusting the thickness of the antireflection layer will set a relatively flat spectral characteristics in a visible light region. Murakami et al. is teaching that by adjusting the thickness of the antireflection layer will adjust the amount [of] different colors [that] will be absorbed. The Examiner finds the Applicant's teachings of adjusting the thickness of the antireflection layer to be the same as Murakami et al.

This teaching, however, would not have motivated one of ordinary skill in the art to modify the thickness of Daly's planarization layer 18 because Daly's planarization layer 18 is not an antireflection coating, as explained above.

In addition, Murakami teaches that his antireflection film 15 should have a thickness on the order of 30-50 nm (see, e.g., col. 2, line 56). Such a thickness would not be sufficient to planarize topographic features of the device region in Daly's imager. Therefore, replacing Daly's planarization layer 18 with Murakami's antireflection film 15 would defeat Daly's objective to provide a smooth, uniform surface over the active device area for a color filter array. A modification that would defeat the object of Daly's invention hardly would have been obvious to one of ordinary skill in the art, as explained above.

For at least these additional reasons, the Examiner's rejection of dependent claim 16 under 35 U.S.C. § 103(a) over Daly in view of Murakami should be withdrawn.

C. Claims 21 and 22

The Examiner has rejected claims 21 and 22 under 35 U.S.C. § 103(a) over Daly. In particular the Examiner has indicated that:

> Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical.

Contrary to the Examiner's assertion, however, the specification clearly explains that (page 7, lines 7-15):

> In the illustrated embodiment, it has been discovered that a BARC layer thickness of approximately 60 nm improves the optical transmission characteristics for each of the colors of an RGB color filter array at the target radiation wavelengths of 620 nm for red, 540 nm for green, and 460 nm for blue. In general, the BARC layer thickness should be relatively thin (e.g., less than approximately 200 nm) so that portions of BARC layer 16 may be removed relatively easily to expose bonding pad 42 and other device structures during the BARC layer removal process step (described below in connection with process step 90 of FIG. 2).

That is, the specification teaches that a BARC layer thickness less than approximately 200 nm (claim 21) allows the BARC layer to be removed relatively easily and a BARC layer thickness of about 60 nm (claim 22) improves the optical transmission characteristics for each of the colors of an RGB color filter array at the target radiation wavelengths of 620 nm for red, 540 nm for green, and 460 nm for blue.

More important, one of ordinary skill in the art at the time of the invention would not have been motivated to make Daly's planarization layer 18 with a thickness less than approximately 200 nm because such a thickness would be unlikely to provide a smooth, uniform surface over the active device area for a color filter array, which is the objective of Daly's invention. Indeed, such a thickness is more than 33% thinner than the lower bound of the "optimum thickness" thickness range taught by Daly (see col. 5, lines 35-36). Similarly, one of ordinary skill in the art at the time of the invention would not have been motivated to make Daly's planarization layer 18 with a thickness of about 60 nm, which is 80% thinner than the lower bound of Daly's optimum thickness range, because such a thickness would not provide a smooth, uniform surface over the active device area for a color filter array.

For at least these additional reasons, the Examiner's rejection of claims 21 and 22 under 35 U.S.C. § 103(a) over Daly should be withdrawn.

C. Claim 23

The Examiner has rejected claim 23 under 35 U.S.C. § 103(a) over Daly. In particular the Examiner has indicated that:

> Referring to claim 23, wherein the bottom antireflection coating is present only in regions under color filter array material (Col. 11, lines 10-22).

Contrary to the Examiner's implication, however, Daly fails to teach or suggest anything about providing a planarization layer 18 that is present only in regions under color filter array material. Indeed, Daly repeatedly teaches that the only areas where planarization layer 18 is removed are the areas over the bonding pads (see, e.g., col. 3, lines 51-52, and col. 5, lines 43-47). The part of Daly's specification cited by the Examiner similarly teaches that the only areas where planarization layer 18 is removed are the areas over the bonding pads.

Moreover, one of ordinary skill in the art would not have been motivated to provide a planarization layer 18 that is present only in regions under color filter array material because such a modification of Daly's planarization layer 18 would defeat the following advantage cited in the Summary section of Daly's disclosure (col. 3, lines 47-51):

> An additional benefit achieved by the use of the described planarization layer arises from the fact that it covers those areas of the wafer which is inactive, so resulting in the reduction of streaks that arise from non-uniform coatings.

That is, Daly teaches away from the modification proposed by the Examiner.

For at least these additional reasons, the Examiner's rejection of claim 23 under 35 U.S.C. § 103(a) over Daly should be withdrawn.

V. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 50-1078.

Respectfully submitted,

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